

AC 2010-1113: DEVELOPING AN ONLINE UNDERGRADUATE ENGINEERING ECONOMY COURSE

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Abstract

Given shrinking university budgets, increased enrollments and limited teaching space, a push has been made to develop online courses at the undergraduate level which will allow for large class sections and increase access, both on-campus and remotely. The development of online courses in engineering at the undergraduate level is new at the University of Florida. We discuss the process of developing an online course in engineering economy. We specifically address how to allow for students to interact in groups in an online environment through projects. We also discuss the ability to modularize delivery in order to appeal to different majors in the course, which may require slightly different content. The course, currently under development, is to be delivered in the Summer of 2010.

Introduction

The introduction and use of distance education approaches and technologies is not new at institutions of higher learning, even in engineering. Many examples exist where students can take entire degrees off campus. However, most of these examples, including those at the University of Florida, are restricted to the graduate level.

In an effort to increase access amidst increasing enrollments and shrinking budgets, the Provost at the University of Florida is funding the developing of numerous online courses for use at the undergraduate level. Funding is provided for technical development of all course materials. The instructor must supply all content. This year, a course is being developed for Engineering Economy – the first engineering course to be developed under the program.

Engineering Economy is taught in three departments in the College of Engineering, including Civil Engineering, Chemical Engineering and Industrial Engineering, at the University of Florida. The course taught in Industrial and Systems Engineering generally has the highest enrollments, with roughly 400 students from Industrial, Mechanical, Electrical, Computer, Computer Science and Materials Science enrolling annually (170 in each fall and spring semester and 60 in the summer).

The course was chosen for development because (a) it impacts a large number of engineering students; (b) development could replace all versions of engineering economy taught in the college; (c) the content was deemed amenable to an online format due to the lack of a laboratory component. This last point serves as the basis of discussion in Ibrahim and Morsi², who show that of 126 institutions studied, 30% offer online degrees. Of these 38 programs, 60% offered Electrical Engineering degrees, with 82.6% of those offering M.S. degrees but only 4.3% offering an online B.S. degree (in 2004).

The benefits of online delivery are obvious to administrators, as physical space is not needed for delivery and thus does not present a limitation on enrollments. However, anecdotal evidence

suggests³ that the time required to deliver a course (i.e., time outside of lecture) can be greater for online courses as more “one-on-one” discussion occurs with students. The benefit to an online course for an instructor is that it can be delivered from anywhere (only phone, computer and internet connection are necessary) and developed coursework, such as lectures, can generally be reused.

The challenge in developing this course was in facilitating student interaction through projects, which were a significant part of the traditional course. Note that this is related, but different, to team lab work, which is becoming more accessible through remote labs². Rather, the challenge here is for students to interact remotely and collaborate on projects. This is something that is generally unnatural to a traditional undergraduate when compared to someone with a full-time job enrolled in an M.S. program.

Course Development

As noted in numerous articles³, developing an online course can be a significant endeavor. To that point, it is generally required that an entire online course be developed before it can be offered, as opposed to traditional formats which allow for a course to be developed over the course of a semester, if desired. Thus, lectures, including notes and their presentation, assignments, quizzes, exams and projects must all be designed in advance of the course’s delivery. (It must be reiterated here that this is an online course, not merely a distance education course with streaming video^{1,5}. This course is completely asynchronous such that the instructor will generally only “meet” students over the phone, via email, or online discussion sessions.)

The Provost’s initiative has clearly reduced the burden of course development often criticized by faculty³ by funding technical support. A course syllabus, outline (which lectures are to be delivered in sequence), slides/materials for each lecture, and assignments were merely “given” to the technology team in the traditional format. In order to facilitate “easier” grading, quizzes and assignments had to be converted to multiple-choice format. Furthermore, instructor time was required to capture any videos required.

The initial design was for the Industrial and Systems Engineering course. However, all course content is delivered in modules, with a module representing a certain topic. A module might contain one or two streaming video lectures, an assignment, a tutorial and a quiz. With this format, certain modules can be removed while others can be inserted in order to deliver similar courses with slightly different content. Thus, it will be possible to include different material, such as increased content on cost estimation through an additional module (or replacing one traditional to Industrial and Systems Engineering), in order to appeal to the Civil Engineering department.

It was also determined that students will have to become familiar with a few technologies (or software programs). These include Illuminate and Google docs. The first program allows students to interact remotely as a group, sharing both video and voice. The second allows them to share documents. With these tools, students will be expected to meet and collaborate in teams to complete projects offered in the traditional course. The specific design process is detailed in the next section.

The Development Process

Fortunately for the instructor, the developed online course was to debut in Summer of 2010 but was being taught in Spring of 2010 in the traditional (live lecture) format. Thus, the development of the online course has occurred in sequence with the traditional deliveries. Specifically, here is the process for a given week of lectures (generally consisting of three):

1. Update lecture notes (slides) as deemed required. In this case, the instructor utilizes examples from current media, so the lecture notes (examples) were updated accordingly.
2. Forward notes to technical support team. Slides are “upgraded” with visuals for examples and background for online course “theme”.
3. Notes are returned to instructor for use in traditional class. Any errors (such as a miscalculation caught by students) are fixed and returned to technical team for final processing. (Steps 1-3 are repeated for all three lectures in a week.)
4. Instructor delivers three lectures in studio captured by video and synched with slide presentation. Note that lectures are broken into 10-15 minute segments during recording.
5. Instructor reviews online presentation for final approval.
6. Technical support team uploads video presentation to online website. Website has a link for each module (a module covers a topic and 1-2 modules may be covered in a week by the students). The module link contains a paragraph overview of module content, lecture links, homework assignment, and quiz.

As seen from the above, the instructor is responsible for creating a homework assignment (problems from the back of a textbook are used in this case) and a quiz for each module. The quiz development is as follows:

1. Module topics to be quizzed are identified.
2. Number of questions per topic identified.
3. Five variations (varied numbers, solutions, etc.) of each question written to reduce the possibility of cheating.
4. Uploaded into online format (using Assessment tool in Blackboard software system).

This essential has led to the development of a test bank of questions.

The final step in the development process has been to write the project descriptions. There are four projects and a final exam for the course:

1. Identification and comparison of two real loans for an automobile of choice. This is performed with a random partner.
2. Development of a spreadsheet tool for economic analysis which must take certain user inputs and provide outputs, such as an after-tax cash, present worth calculation and a few graphs. This is performed with up to five partners, chosen by the team.
3. Completion of a case study of a real investment opportunity. This is performed with up to five partners, chosen by the instructor.

4. Perform a replacement analysis of a personal vehicle. This is performed alone.
5. The final exam constitutes a case study analysis performed alone within a time limit.

To facilitate these projects, the online course website has tutorials, developed by the technical support staff, on the following technology aids:

1. GoogleDocs. This free software allows students to easily share documents, including spreadsheets. The spreadsheet software has nearly all the capability of commercial software.
2. Illuminate. This software allows a team to hold remote meetings, both with audio and slide show capability.

To complete the course design, the above project descriptions are uploaded to the appropriate module along with links to the tutorials. Rubrics are also provided such that the students understand how the projects will be graded.

Experiment

As noted earlier, the online course is to be prototyped in the Summer of 2010 with a traditional lecture format being utilized in the Spring 2010 semester. Data is to be collected in terms of pre- and post-tests in order to assess and compare the learning of students in each environment. Specifically, it is aimed to determine whether there is a difference in learning given the two environments (nearly all lecture slides, assignments and quizzes will be identical, in addition to the instructor). Feedback will also be sought as to how students work in teams in the online environment. Prior research showed the learning (measured via grades) was improved through an online format when focusing merely on the delivery of lectures⁶. Feedback will also be captured in terms of time that the faculty member spends in delivering the course in each format.

Conclusions

An online Engineering Economy course is under development and will debut in Summer of 2010. Data is to be collected which will help determine whether student learning is impacted by the delivery. Information is also to be collected with respect to instructor time for delivery; instructor experience; student experience; and student interaction in groups. Results will be presented at the conference.

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